Evaluation of Thermal Neutron Cross Sections and Neutron Separation Energies for Isotopes of all Naturally Abundant Elements*

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An IAEA Coordinated research Project on the Development of a Database for Prompt Gamma-ray Activation Analysis (PGAA) was started in 1999 to evaluate thermal neutron capture gamma-ray energies and cross section yields. New measurements were performed for about 80 elements with the cold neutron beam at the Budapest Reactor. Thermal gamma ray cross-section yields were determined relative to the ^{1}H(0.3326 b) standard with a precision of 1-5%, and energies were measured to ±0.05 keV. These measurements were then combined with isotopic data from the literature to produce more complete data for each isotope.

These data were combined into thermal neutron capture decay schemes which were usually sufficiently complete to determine total neutron capture cross sections from the total gamma-ray cross section populating the ground state and/or the total gamma-ray cross section deexciting the capture state. In some cases additional cross section information was derived from decay gamma-ray intensities observed in the Budapest experiments. Neutron separation energies were determined from a least-squares fit of the primary and secondary gamma-ray energies to the level scheme.

A new, self-consistent set of thermal neutron cross sections is near completion and will be used to revise the 1981 BNL-325 data compilation. The new neutron separation energies will be made available to the Atomic Mass Data Center in Orsay for inclusion in their mass compilations. Some preliminary results are shown in the attached table.

Footnotes and References

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Preliminary Comparison of IAEA/CRP and Literature Thermal Neutron Cross Sections and Neutron Separations Energies

Isotope	Abundance	Sn(Audi95)	Sn(2001)	s(1981)	s(2002)
1H	99.9885(70)	2224.5725(22)		332.6 mb 7	≡332.6 mb
2H	0.0115(70)	6257.2482(24)		0.519 mb 7	0.492 mb 25
3He	0.000137(3)	20577.62		0.031 mb 9	
4He	99.999863(3)				
6Li	7.59(4)	7249.96(9)	7249.94(4)	39 mb 3	52.6 mb 22
7Li	92.41(4)	2033.8(3)	2032.57(4)	45 mb 3	45.7 mb 9
9Be	100	6812.33(6)	6812.10(3)	7.6 mb 8	8.8 mb 6
10B	19.9(7)	11454.12(20)	11454.15(14)	500 mb 200	303 mb 20
10B(n,α)				712.5 b 17	712.5 b
11B	80.1(7)	3370.4(14)		6 mb 3	
12C	98.93(8)	4946.310(10)	4946.311(3)	3.53 mb 7	3.89 mb 6
13C	1.07(8)	8176.440(10)	8176.61(18)	1.37 mb 4	1.22 mb 11
14N	99.632(7)	10833.230(10)	10833.317(12)	75 mb 8	79.0 mb 9
15N	0.368(7)	2490.8(23)		24 mb 8	
16O	99.757(16)	4143.33(21)	4143.06(10)	0.190 mb 19	0.189 mb 8
17O	0.038(1)	8044.4(8)		0.54 mb 7	
18O	0.205(14)	3957(3)		0.16 mb 1	
19F	100	6601.31(5)	6601.344(16)	9.6 mb 5	9.50 mb 11